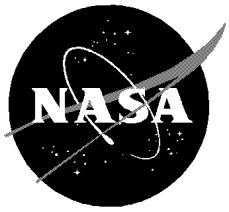
Hitchhiker Reactivation Plan

Electrical

Basic

December 2003



National Aeronautics and
Space Administration

Shuttle Small Payloads Project Office

Goddard Space Flight Center
Greenbelt, Maryland

870-PLAN-085

Hitchhiker Reactivation Plan - Electrical

Prepared by: _____ 12/19/03
Michael R. Wright/568 — Date
Hitchhiker Lead Electrical Engineer

Reviewed by: _____ 12/22/03
Mary Boloori/OSC — Date
Hitchhiker Electrical Engineer

Reviewed by: _____ 12/24/03
Ken McCaughey/OSC — Date
Hitchhiker Electrical Engineer

Approved by: _____ 1/5/03
Gerard J. Daelemans/870 — Date
Chief, Shuttle Small Payloads Project Office

REVISIONS

REVISION	DESCRIPTION	DATE	APPROVAL
Basic	Baseline release	Dec. 2003	

1.0 INTRODUCTION

1.1 PURPOSE

This plan presents the actions necessary to "reactivate" the Hitchhiker (HH) carrier electrical system, including flight hardware and ground support equipment (GSE), following "hibernation" and subsequent call-up for flight integration.

This plan assumes that the carrier hardware has been retrieved from storage and transferred to a cleanroom test area to begin the reactivation process. Work with flight hardware is to be performed in the GSFC Building 5 cleanroom, or equivalent class 100,000 cleanroom.

1.2 PLAN IMPLEMENTATION

The Hitchhiker lead electrical engineer shall be responsible for implementing this plan and shall be the single-point contact for all electrical operations. The electrical support contractor shall support the lead electrical engineer in accomplishing specific tasks identified by the lead engineer.

The estimated "fast-track" schedule for reactivation of the Hitchhiker carrier electrical system, from initial call-up for flight, is:

- Establishing team and training/retraining personnel: 1 month
- Identifying required hardware and relocating to GSFC: 1 month
- Cleaning, inspection, setting up the test area: 2 months
- Gathering documentation, performing box-level testing: 2 months

TOTAL: 6 months

I think some time could be saved wrt clean, inspection, test area setup.

1.3 REFERENCES

General Documents:
Hitchhiker Customer Accommodations and Requirements Specification (740-SPEC-008)
Integration & Test of Shuttle Small Payloads (NASA TM 2003-211611)
Crimping, Interconnecting Cables, Harnesses, and Wiring (NASA-STD-8739.4)
Goddard Directives Management System (for applicable GPG's and PG's)
SSPP On-Line Archive (TBD)

Electrical Integration and Test (I&T) Procedures:
HH Hardware Refurbishment procedure (HH-PROC-090)
HH/Customer Electrical Integration and Test (870-PROC-591)
HH Avionics Functional Test (870-PROC-0363)
Avionics EGSE Unpacking, Setup and Check out (870-PROC-0348)
Thermal Multiplexer (Mux) Board-Level Functional Test (870-PROC-584)

HH Video Interface Unit (HVIU) Box-Level Test (HH-TEV-048)
Electronics Mounting Plate (EMP) Heater Verification (870-PROC-585)
Single-Bay Pallet (SBP) Functional Test (HH-PROC-098)
Double-Bay Pallet (DBP) Functional Test (OAST-PROC-027)
Lightweight Avionics Plate (LAP) Functional Test (SSPP-PROC-130)
HH-J Lower End Plate (LEP) Pressure Transducer Calibration Test (AHH-PROC-014)
HH Remote Interface Unit (HRIU) LEP Functional Checkout (870-PROC-0204)
HRIU to HH-J LEP Electrical Integration & Functional Verification (870-PROC-0207)
HRIU Level 1 Functional Test Procedure (870-PROC-0208)
HRIU Level 2 Functional Test Procedure (870-PROC-0209)
HH Motorized Door Assembly (HMDA) GSE Operating Procedure (870-PROC-0407)
HH Ejection System Electronics (HESE) Functional (Test) with the Ejection System GSE (SSPP-PROC-132)
HESE Integration and Performance Verification (HH-PROC-163-07)
LEP Transducer Calibration
HMDA Functional
ACE Component Functionals
BIA Functional

Flight and Ground Hardware Listings:
Electronics assemblies and subassemblies
Harnesses
Spare parts
Simulators
Test Equipment
HMDA/HESE GSE

2.0 GENERAL REQUIREMENTS

2.1 SAFETY

Standard OSHA safety requirements shall apply during all I&T operations. Some unique safety requirements may apply in cases where hazardous materials or other dangers exist. Potential hazards related to HH carrier electrical systems include high voltages, pyrotechnic devices, and sharp edges.

It is everyone's responsibility to ensure operations are conducted in a safe manner. However, the test conductor (TC) shall be ultimately responsible for the safety of the test team and the hardware.

2.2 QUALITY ASSURANCE

A Work Order Authorization (WOA), per GPG-5330.1, must be issued before work is started. The quality assurance (QA) representative shall be notified 24 hours prior to the execution of this procedure. I&T activities involving flight hardware shall be monitored at the discretion, except for Mandatory Inspection Points (MIP's), of the GSFC Code 300 Quality Assurance authorized representative.

Once flight integration has begun, any change to flight or GSE configuration (hardware, software, or firmware) must be documented on a Configuration Change Request (CCR). Any anomaly or problem must be recorded on a Nonconformance Report/Corrective Action (NCR/CA), per GPG-5340.2, and a copy attached to the WOA. The TC shall be responsible for addressing NCR/CA's and maintaining WOA's.

2.3 GROUNDING

All hardware shall be grounded at a common ground point during the test procedure.

All personnel handling hardware which is electrostatic-discharge (ESD)-sensitive shall wear electrostatic wrist straps attached to the wrist's skin area and to the end unit's ground strap. Wrist stats shall always be used when mating or demating cables, and when performing electrical measurements on flight hardware.

When pyrotechnics are installed in the carrier system, ESD-resistant garments (including gloves) shall also be worn.

2.4 CLEANLINESS

Flight hardware shall be stored in cleanroom environment when not protected by a double-wrapping or storage container. All personnel shall wear clean-room garments and gloves while inside cleanroom.

3.0 PERSONNEL REQUIREMENTS

3.1 ELECTRICAL TEAM

The HH carrier electrical team shall be established to include, at a minimum, the following personnel:

- Lead electrical engineer (typically the I&T manager)
- Carrier electrical engineer (may include engineers for electrical subystems and I&T)
- Carrier electrical technician (may include techs for fabrication and I&T)

The TC for a given test/procedure may be any one of the above personnel.

3.2 TRAINING

All electrical personnel shall be properly trained and certified to perform their respective tasks. Examples of training and certification include:

- Flight hardware handling and cleanliness
- ESD protection
- Electrical soldering
- Crimping, cabling, and harnessing
- Pyrotechnic device (ordinance) handling

In addition, personnel performing specific tasks shall be familiar with the associated hardware, software, and applicable procedures. Training and familiarization with the Advanced Carrier Customer Equipment Support System (ACCESS) is also recommended.

Lastly, it is highly recommended that Hitchhiker I&T personnel review applicable portions of the Hitchhiker online archive at (TBD). It is also recommended that personnel read the highly acclaimed NASA publication "Integration & Test of Shuttle Small Payloads" (TM 2003-211611) prior to start of I&T.

4.0 HARDWARE

4.1 FLIGHT ELECTRONICS

Listings of all HH carrier electrical flight hardware are included in the following Configuration Management (CM)-controlled documents:

Electronics assemblies and subassemblies: TBD (see below)
Spare subassemblies: TBD = PCM (2), MRM (1), AIA (1)
Spare parts: TBD = 1865
H□H carrier electronics: Avionics (3), t'mux (2), filter box (1), A6 box (4), HESE (4), MPIB(1), DMPIB (1), HH-J LEP (1), HMDA (3), BFV-valve LEP (3), ACE components: HRIU (7), HCU (2), (not flight hardware)PDU (1), thermal RIU (1), HRIU box (1), BIA (4)(?)

Hitchhiker carrier flight hardware was transferred (at the end of CY 2003) from Greenbelt/Beltsville, Maryland, to Wallops Flight Facility (WFF), Wallops Island, Virginia. At that time, it was stored in WFF Building F-7, which has an environmentally controlled cleanroom facility.

It should be noted that the FREESTAR carrier flight hardware recovered following the STS-107 accident is permanently stored at the Kennedy Space Center in Florida. Archived photos of all the recovered FREESTAR hardware are stored in the Shuttle Small Payloads Project (SSPP) CM archives.

4.2 BIA/PGSC (NOTE: the name was changed to BIA since they were used for both GAS and HH hardware)

There were 8 Bus Interface Adapters (BIA's) available in flight inventory. 4 units were transferred to Wallops in 2000 for GAS hardware and test support, as part of the GAS program transfer to WFF. These are S/N's 01, 02, 03, and 08. The configuration of these BIA's had the +/-12VDC signal disabled since they were only required for the HH-J interface. S/N 04, 05, 06, and 07 were part of the HH inventory, and supported the HH-J carrier. S/N's 005 and 007 were damaged in the 107 accident.

The BIA requires the use of a Payload General Support Computer (PGSC). For testing at Goddard, the PGSC is simulated using a nonflight equivalent (IBM Thinkpad 760XD) computer that can run the same flight software as that used during the mission.

The user of the PGSC/BIA systems must be aware of the ever changing PGSC platforms used by the Shuttle and ISS programs. When re-activation takes place, the I&T Manager will have to contact the Shuttle program to identify the PGSC platform currently in use, and establish compatibility with the existing PGSC flight software. Prior to HH hiberation, the ACE electrical lead was involved with a trade study and compatibility test program preparing for the next generation PGSC operating system (windows 2000), and developing GUI interfaces for the HH-J system.

PGSC mission software shall be verified and acceptance tested prior to delivery for flight.

4.3 FLIGHT HARNESSES

There are 162 flight harnesses in storage at WFF. A comprehensive list is included in document TBD.

Flight harnesses may be reflown if length and connector configurations match mission-unique requirements. Harnesses selected for reflight shall be inspected and tested per NASA-STD-8739.4. This shall include continuity, insulation resistance, and dielectric withstanding voltage (DWV) testing.

Although standard cleanliness practices are observed during handling of flight harnesses, bake-out of harnesses is usually not necessary if cleanliness is maintained and there are no mission-unique requirements to mitigate contamination.

4.4 GROUND SUPPORT EQUIPMENT

Various electrical ground support equipment (EGSE) is used for testing the various HH carrier electrical end items. GSE which incorporates Inspection Measuring and Test Equipment (IMTE), such as meters and power supplies, shall be calibrated prior to use.

Listings of all HH EGSE are included in the following SSPP CM-controlled documents:

Simulators: ODERACS, HRIU, Avionics plate, HVIU, Low-Rate, HH Load, Orbiter Wiring,
Avionics Bench, MRM Test Gen.
I&T GSE: OSR (4), AOSR (1), HRIU racks (2), HMDA (4), HESE (2)
Misc. GSE: SIP boxes, cables, parts, test equipment, tools

HH EGSE was transferred (at the end of CY 2003) from Greenbelt/Beltsville, Maryland, to WFF, Wallops Island, Virginia. At that time, it was stored in WFF Building M20 storage facility.

The ACCESS was transferred from Goddard Building 5 to Building 14. This system may be required for tests involving the HH Avionics, and is typically handled and operated by ground data systems personnel.

5.0 TEST OPERATIONS

5.1 TEST AREA

The area selected for testing flight hardware shall be Class 100,000. Temperature shall be maintained between 60F and 80F, and relative humidity between 30% and 50%.

For bench-level testing, in the event that a cleanrooom is unavailable, lab space that is visibly clean may be used. In this situation, a dedicated ESD-protected area for flight hardware testing is required, and all electronics assemblies must remain closed (i.e, within electronics boxes or with covers on).

5.2 HARDWARE PREPARATION

Any flight hardware or EGSE that is retrieved from storage for testing shall be transferred to a receiving area prior to being put in the cleanroom. Receiving and inspection shall be performed in accordance with established QA requirements. The hardware container shall be cleaned, or exterior wrap removed, prior to transferring hardware into the cleanroom.

Once in the cleanroom, visual inspection shall be performed of the hardware exterior and, if feasible, interior. In the case of flight hardware having fuses, these items shall be replaced prior to testing for flight. Since Hitchhiker is considered a Class-D payload carrier, only those circuits to be used during the mission are usually refurbished and retested.

Pressure transducers on Hitchhiker Lower End Plates (LEP's) are considered limited-life items and should be replaced, depending on criticality of pressure telemetry during the mission.

Flight hardware, under all circumstance, shall be handled using cleanroom gloves. All flight electrical hardware shall be handled using wrist-stats.

5.3 TEST PROCEDURES

Test documentation shall be prepared and approved prior to testing, as outlined in Section 2.1. Procedures listed in Section 1.3 may be used, as applicable, or new procedures generated.

Test procedures shall be executed by the test conductor and witnessed at the discretion of the QA representative. Each procedure shall become a quality record which, upon completion, is archived into CM.